MAJOR CORRECTION FOR VESA-2 REGARDING THE METHOD OF FLOWINGTHE AIR FROM THE BOTTOM TO THE TOP

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RESEARCHARTICLE

MAJOR CORRECTION FOR VESA-2 REGARDING THE METHOD OF FLOWINGTHE AIR FROM THE BOTTOM TO THE TOP

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ABSTRACT

A series of measurements and observations have already conducted regarding the temperature distribution and the safety of exhaust fan attached at the top of Vesa-2. Vesa-2 is an equipment created to prevent the exposure of gaseous emissions from the charcoal fire to the people who roast kemplang manually and traditionally in Palembang, South Sumatra Indonesia. The attachement of exhaust fan at the top of Vesa-2 has corrected regarding fluctuating heat resulting from the live charcoal at the bottom. Some reasons has outlined including the uncontrolled volume of charcoal burnt, the amount of air flown, the quality of charcoal and the uniformity of burning.Measurements show the better results and safety for the fan positioned at the bottom. The exit gas temperatureand velocity0.92 m/sec; 45 ^{0}C much lower than the application of exhaust fan positioned at the top which 80.15 ^{0}C and 3.64 m/sec

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INTRODUCTION

Vesa-2 is an equipment that is used for eliminating the heat, the gases and the particulates that comes out of wood charcoal burning on an open stove. This equipmentis required to support Indonesia Maju program by modernizing the kemplang roasting process, from the traditional way as can be seen in many placesat present to a more better and healthier way of process. Figures 1a, 1b arethe way mothers used to roasts the kemplang in Palembang. Kemplang is a traditional crunchy snack made from a mixture of wheat, egg and fish. This food is liked by most of the people in Palembang. It sold in many places, shops and on the roadsides as presented in Figure 1c and 1d (Darmawi, 2014) Attention has already given to this roasting process since 2014. The main attention isfocused on the process of roasting where the gas, the smoke, the heat and particulates emitted from the combustion of open wood charcoal stove. It spreads in all directions, it contaminates the surroundingair and harmful to the breath of mothersand people around it. The heat, the gas, the smoke and the particulates are harmful to mothers who roast the kemplang by that means. That is the main problems this equipment focused on (Darmawi, 2021) In order to overcome the problems, the first equipment created to eliminate these problems is shown in figure 2, the horizontal energy saver.

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The wood charcoal stove put atthe bottom of the equipment, a small exhaust fan will inhale the gas, the heat, the smoke and the particulates produced by the charcoal at the stove, bring it to the inside of Hesa and flow it to the top and deliver it to the atmosphere. While flowing, the gases will passed through aset of kemplangsarranged to preheat. After that, the gases will delivered to the atmosphere away from mothers breath. This equipment is registered as an intellectual rights at Depkumham RI, in 2016. This equipment is thenleft behind and not developed (Dr.Ir.Darmawi, 2014). In January 19th, 2017 we create a new equipment named PenghematEnergiVertikal (Vertical Energy Saver) or we called it VESA. It registered at Depkumham RI and get the patent rights at december10th, 2019 (Darmawi, 2019). Figured 3, show the schematic figuration of VESA, where the wood charcoal stove put at the bottom of the equipment, while theexhaust fan inhale the air from the bottom to the top and delivered it to the atmosphere. Vesahas already developed and changed in many ways. The developed results called Vesa-2 (Darmawi, 2019). Since the beginning, the heat from the stove at the bottom has been detected asa problem for Vesa-2 with exhaust fan positioned at the top.(5)The exhaust fan sucts the air and force it to flow from the bottom to the topand delivered it to the atmosphere. The fluctuation of heat regarding the uncontrollable amount of wood charcoal burnt is functually fluctuates the temperature inside the Vesa-2. The relatively high temperature of exit gas of is influenced the performance of the fan and its lifetimein accordance with the low ability of appliances to resist the heat.

(a)

(b)

(c)

(d)

Figure 1. The activity of kemplang roasting and selling manually in Palembang since the age.of decades

Figure 2. Horizontal energy saver(Hesa)

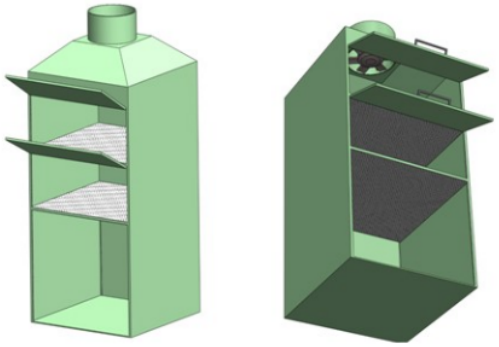

Figure 3. The schematic Vesa-2 with inhale fan at the top

To overcome the problems, the use of steel bladed fan has already tried. But the problems still existed and persisted . The electrical components of fan partially melted and downgraded the fan performance and effectivity. It seems that the principle of air flowing from the bottom to the top should be changed. The basic changed including the mechanism of air flowing, where the current mechanism is the fan inhaled the air from the top of Vesa-2. The alternative mechanism is blowing the air from the bottom to the top.The blowing fan positioned at the bottom of Vesa-2 and blowing as much as 410 m^3/hr the air from the bottom to the top of Vesa-2 and delivered the emission gases to the atmosphere at the top outlet gate. Figure 4 shows the distribution of temperature inside the column of Vesa-2 when the air inhaled by the exhaust fan at the top. The average exit temperature is at about 80.15^0C. In contrast with the use of blowing fan, installed at the bottom of Vesa-2. The exit temperature and the velocity of emissions flewmuch lower than the use of exhaust fan. It about 0,92 m/sec in speed and 44,58 ^{0}C in temperature. This temperature much friendly for the fan of Vesa-2 according to the smooth operation and the long lifetime (Darmawi, 2022)

The method of experiments: To find out the real different of both methods of flowing the air from the bottom to the top of Vesa-2, the experiments and measurements are already conducted. The test is carried out on Vesa-2 with column sizes of (34x34x110) cm and (36x36x120) cm. The quantity of wood charcoal burnt was limited by weight of 1 kg. The measurements carried out three times at each position and conducted at 20 minutes after the uniform burnt of wood charcoal is observed (Darmawi, 2022).

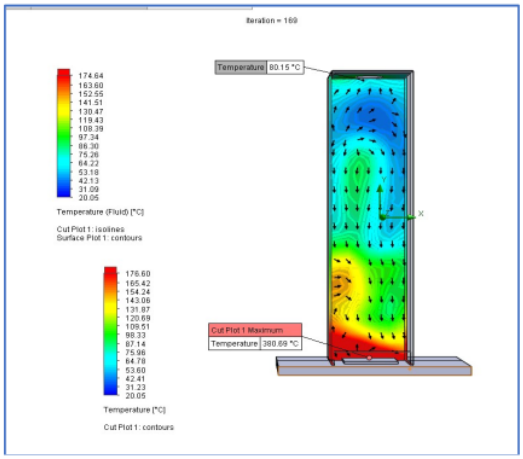

Figure 4. The distribution of temperature inside VESA-2 when the air inhaled from the top

Figure 5. Blowing fans attached at the bottom sides of Vesa-2 to flow the air from the bottom to the top

Figure 6. An inline duct fan of steel blades inhale the air from the top of Vesa-2

The air box is constructed as shown in figure 7 can be installed and removed from the bottom of VESA-2 as for the purpose of experiments and measurements.

The air box main trusses is made of low carbon steel and the wall of the column surround it is made of alcan sheet of 0.48 mm thick. The air is inhaled from the atmosphere and blew it to the inside of VESA-2 and let it flow through the charcoal stove and ascend the column to the top of Vesa-2 and delivered it back to the atmosphere.

RESULTS AND DISCUSSION

It is very hard to find an exact results of temperature of wood charcoal or even coal briquette, regarding the volume of burnt, the kind of wood made, the quality of process and the size of charcoal itself. It is why the results is an average value of three times measurements of the same position and same location.

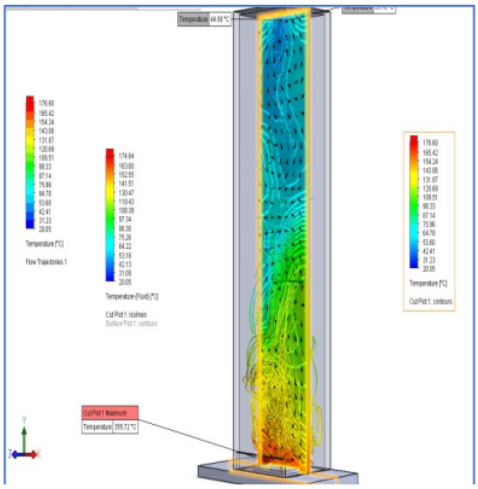

Figure 6. Temperature distribution inside the column of Vesa-2 with air flown from the bottom to the top by blowing fan positioned at the bottom of Vesa-2

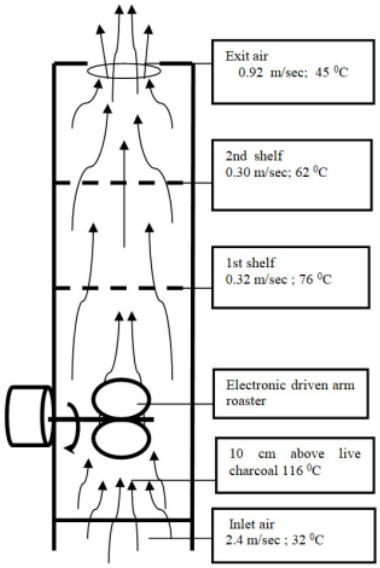

Figure 7. Velocity and temperature profile of the air flowing in the column of VESA-2 whenthe air is blew from the bottom to the top

The air is then filtered by steel plates with holes positioned as the bottom plate of Vesa-2 to produce a uniform air flow and flowing through the charcoal stove at above it slowly. We found a speed decrement of air flow in the column of Vesa-2 and a decrement of exhaust temperature as well. The roof top of Vesa-2 is made horizontal, no angle formed at the exit part of Vesa-2. The form of this kind regarded as has influenced to the distribution of temperature inside the column. The temperature tend to uniform at all part of the inside of Vesa-2 after ninety minutes of burning (Juhan, 2016). This matter will considered when decisions of shape and final construction size of Vesa-2 should made. From the previous experiments of wood charcoal burning that has conducted five times in Vesa-2, no problems found at the blowing fanwhen it attached at the below side of Vesa-2.From the experiments and measurements carried out, the using of blowing fan at the bottom of Vesa-2 gives some advantages compared to the use of exhaust fan positioned at the top of Vesa-2. The advantages areas the the followings:

- The exit temperature is in the range of 42^0C – 45^0C much lower than using the suction fan positioned at the top where the exit temperature ranging from 78.12^0C – 80.15^0C.
- The average speed of flowing air in the column of Vesa-2 is 0.92 m/sec about three-quarter lower than using the exhaust fanpositioned at the same outlet diameter.
- The observation shows the quantity of fly ash particles suspended in the exhaust gases significantly decrease by using blowing fan.
- The experiments show that single blowing fan is enough to supply air to maintain the charcoal fire. The blowing fan supplied about 110 m^3/hour air supplied from the atmosphere to pass through the Vesa-2

CONCLUSION

From the resultsof the experiments and masurements, we can withdraw the following conclusions:

- The use of blowing fan, positioned at the bottom of the Vesa-2 is more advantages than using exhaust fan positioned at the top of Vesa-2mainly according to the speed and the temperature of exit air flow.
- The use of wood charcoal is better than the use of coal briquette for Vesa-2 considering the gas emissions, the cost of productions and the health ofmothers kemplang roasters.
- The size of Vesa-2 of (36x36x120) cm shows a better performance in heat absorbance and calorie utilization in Vesa-2 rather than (34x34x110) cm.

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